GRAPEVINE CANYON G-E-M RESOURCES AREA

(GRA NO. NV-21)

TECHNICAL REPORT

(WSAs NV 050-0354 and 050-0355)

Contract YA-553-RFP2-1054

Prepared By

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Final Report

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EXECUTIVE SUMMARY

The Grapevine Canyon Geology-Energy-Minerals (GEM) Resource Area (GRA) is about 30 miles northwest of Beatty in Nye and Esmeralda Counties, Nevada and Inyo County, California. There are two Wilderness Study Areas (WSAs), NV 050-0354 and NV 050-0355; the former is in Esmeralda County except for its eastern tip which is in Nye County, and the latter is bisected by the Esmeralda-Nye County line. The Nevada-California border forms the southwestern boundary of both WSAs.

Near the north edge of the GRA there are extensive exposures of sedimentary rocks about 600 million years old that were intruded by large granitic bodies about 200 million years ago. Metallic mineralization in the GRA is related to this period of intrusion. Much of the GRA and much of both WSAs are covered by volcanic rocks 10 million to 25 million years old, which are displaced by numerous faults. A large area in the middle and eastern part of the GRA, including parts of both WSAs, is covered by very young gravels.

The Gold Mountain or Tokop district, which has small recorded production of gold and a little tungsten, is near the north edge of the GRA and part of it extends into WSA NV 050-0354. A small area with limited silver production is in the northwest corner of the GRA adjacent to the west edge of WSA NV 050-0354 and extending somewhat into the WSA. North of the GRA there are a great many small mines and mineral occurrences, mostly for precious metals but some for tungsten, a strategic and critical metal, or for base metals.

There are numerous patented claims in the Gold Mountain district, and some of them lie very close to or just within WSA NV 050-0354. There are also numerous unpatented claims west of the Gold Mountain district, and at least a couple dozen of them lie within the northern boundary of WSA NV 050-0354. There are no oil and gas or geothermal leases.

The northern one-third of WSA NV 050-0354 is classified as highly favorable with a moderate level of confidence for metallic mineral resources (precious and base metals and tungsten). The remainder is classified as having low favorability with a low level of confidence. All of the WSA is classified as having low favorability with a low level of confidence for uranium and thorium. About one-third of the WSA is classified as having moderate favorability with a moderate level of confidence for sand and gravel deposits, while the remainder is classified as having low favorability with a low level of confidence for nonmetallic mineral resources. Oil and gas has very low indicated favorability with a high confidence level. Geothermal resources has a moderate favorability and confidence level.

All of WSA NV 050-0355 is classified as having low favorability for metallic mineral resources, with a low level of confidence. All of it is classified as having low favorability for uranium and thorium, with a low level of confidence. About half of it is classified as having moderate favorability for sand and gravel deposits, with moderate confidence, while the remainder is classified as having low favorability for nonmetallic mineral resources with a low level of confidence. The classifications for oil and gas and geothermal are the same as for WSA 050-0354.

No additional work is recommended for WSAs NV 050-0354 and 050-0355.

I. INTRODUCTION

The Grapevine Canyon G-E-M Resources area (GRA No. NV-21) contains approximately 350,000 acres (1,400 sq km) and includes the following Wilderness Study Areas (WSA):

WSA Name	WSA Number
Queer Mountain	NV-050-0354
Bonnie Claire Flat	NV-050-0355

The GRA is located in Nevada and California in the Bureau of Land Management's (BLM) Stateline/Esmeralda Resource Area, Las Vegas district. Figure 1 is an index map showing the location of the GRA. The area encompassed is near 37°14' north latitude, 117°15' west longitude and includes the following townships:

T 7 S, R 40-43 E	T 8 S, R 40-43 E
T 9 S, R 41-44 E	T 10 S, R 42-44 E
T 11 S, R 42-45 E	

The areas of the WSAs are on the following U. S. Geological Survey topographic maps:

15-minute:

Ubehebe Crater

7.5-minute:

Gold Point, SW	Gold Point
Bonnie Claire, NW	Bonnie Claire
Bonnie Claire, SW	Bonnie Claire, SE

The nearest town is Gold Point which is located about four miles north of the northern GRA boundary. Access to the area is via U.S. Highway 95 to the northeast. Access within the area is via unimproved light duty and dirt roads scattered throughout the GRA.

Figure 2 outlines the boundaries of the GRA and the WSAs on a topographic base at a scale of 1:250,000.

Figure 3 is a geologic map of the GRA and vicinity, also at 1:250,000. At the end of the report, following the Land Classification Maps, is a geologic time scale showing the various geologic eras, periods and epochs by name as they are used in the text, with the corresponding age in years. This is so that the

reader who is not familiar with geologic time subdivisions will have a comprehensive reference for the geochronology of events.

This GRA Report is one of fifty-five reports on the Geology-Energy-Minerals potential of Wilderness Study Areas in the Basin and Range province, prepared for the Bureau of Land Management by the Great Basin GEM Joint Venture.

The principals of the Venture are Arthur Baker III, G. Martin Booth III, and Dennis P. Bryan. The study is principally a literature search supplemented by information provided by claim owners, other individuals with knowledge of some areas, and both specific and general experience of the authors. Brief field verification work was conducted on approximately 25 percent of the WSAs covered by the study.

None of the WSAs in this GRA were field checked.

One original copy of background data specifically applicable to this GEM Resource Area Report has been provided to the BLM as the GRA File. In the GRA File are items such as letters from or notes on telephone conversations with claim owners in the GRA or the WSA, plots of areas of Land Classification for Mineral Resources on maps at larger scale than those that accompany this report if such were made, original compilations of mining claim distribution, any copies of journal articles or other documents that were acquired during the research, and other notes as are deemed applicable by the authors.

As a part of the contract that resulted in this report, a background document was also written: Geological Environments of Energy and Mineral Resources. A copy of this document is included in the GRA File to this GRA report. There are some geological environments that are known to be favorable for certain kinds of mineral deposits, while other environments are known to be much less favorable. In many instances conclusions as to the favorability of areas for the accumulation of mineral resources, drawn in these GRA Reports, have been influenced by the geology of the areas, regardless of whether occurrences of valuable minerals are known to be present. This document is provided to give the reader some understanding of at least the most important aspects of geological environments that were in the minds of the authors when they wrote these reports.

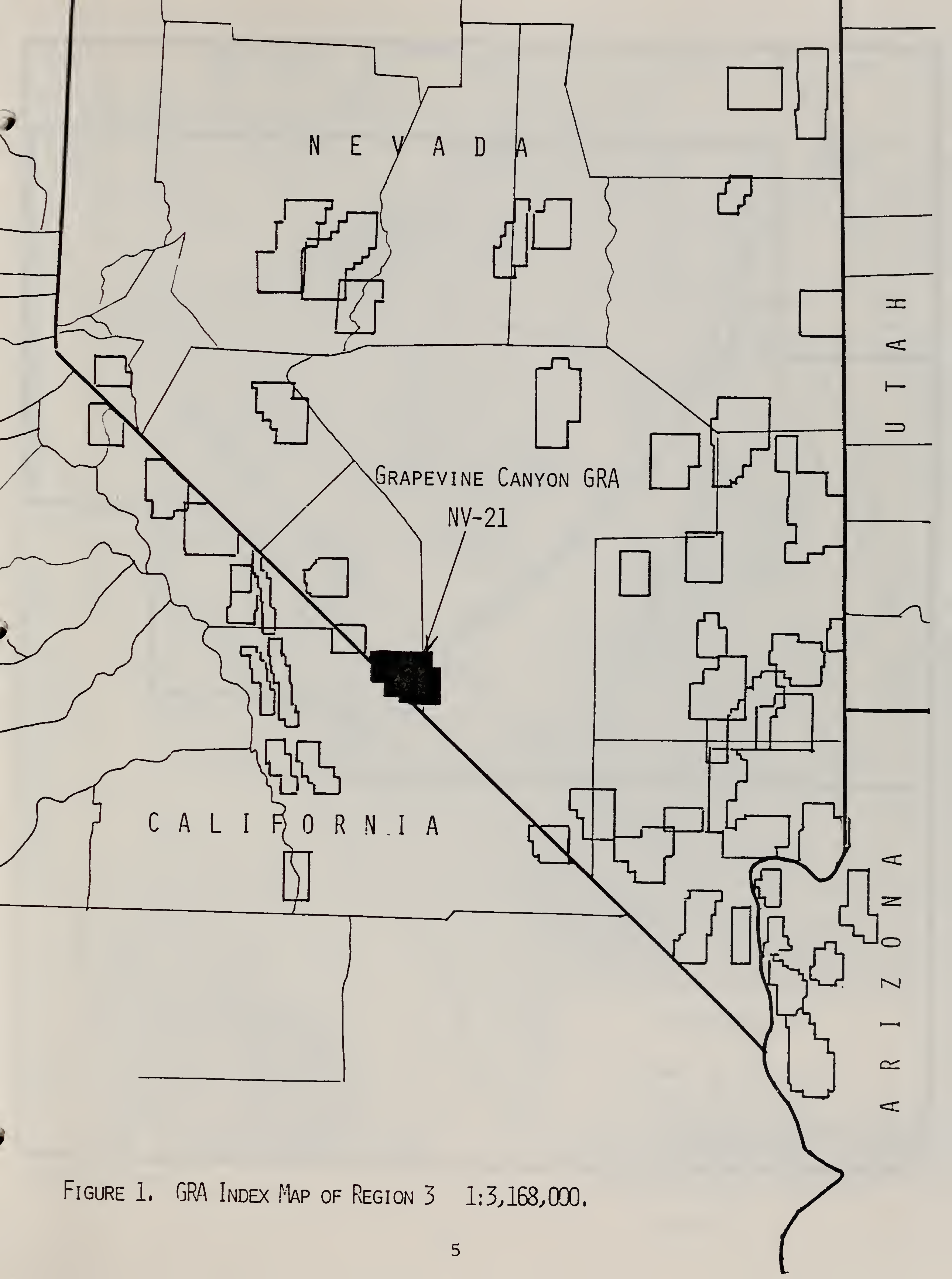
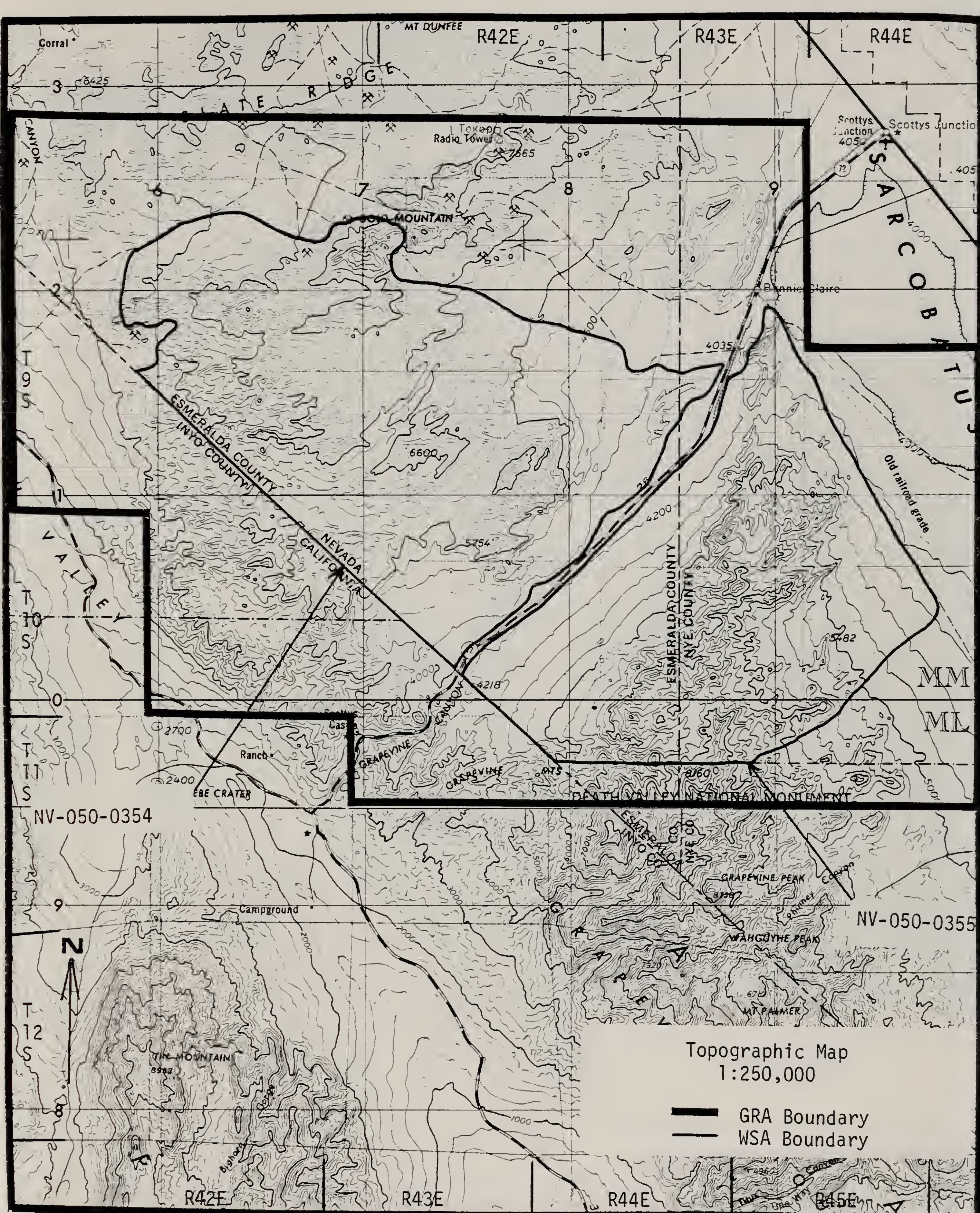


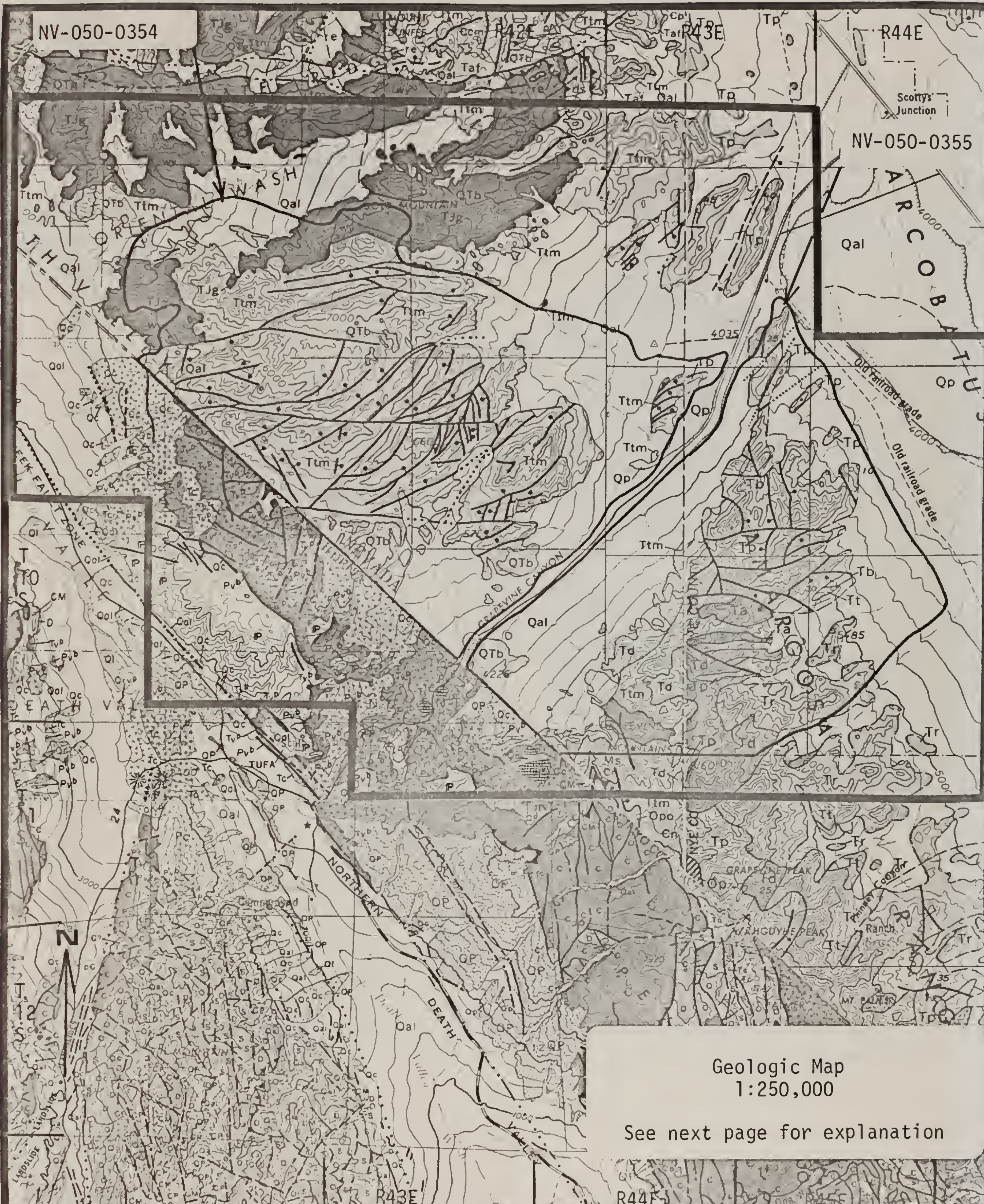
FIGURE 1. GRA INDEX MAP OF REGION 3 1:3,168,000.



Goldfield Sheet

Grapevine Canyon GRA NV-21

Figure 2



Albers and Stewart (1972):
Strand (1976): Cornwall (1972)

Grapevine Canyon GRA NV-21
Figure 3

Holocene

Pleistocene or Holocene

GOLDFIELD HILLS, MONTEZUMA RANGE, CLAYTON RIDGE, AND MOUNT JACKSON RIDGE

SLATE RIDGE AND SOUTHERN END OF COUNTY

QUATERNARY

Ql

Landslide deposits

...ed dolomite

CAMBRIAN

PRECAMBRIAN

High-angle fault

Dashed where approximately located; dotted where concealed. Bar and ball on downthrown side. Queried where doubtful

Low-angle fault or thrust

Dotted where concealed. Sawteeth on upper plate

Anticline

Showing crestline

Syncline

Showing troughline

Note: The Esmeralda Formation is herein restricted to include only the predominantly sedimentary upper unit as mapped by Ferguson and others (1953), and to exclude the Fraction Breccia from its lower part. The Spearhead was reduced in rank to a member of the Thirsty Canyon Tuff by Noble and others (1964)

Geology mapped 1960-63

EXPLANATION

Qal
Desert wash, colluvium, alluvium, and playa deposits

Qp
Playa lake deposits

Holocene

Pleistocene or Holocene

Pliocene or Pleistocene

Pliocene

Miocene

QUATERNARY

TERTIARY OR QUATERNARY

TERTIARY

WHITE MOUNTAINS, VOLCANIC HILLS, NORTH END OF FISH LAKE VALLEY, MILLER MOUNTAIN, AND CANDELARIA HILLS

Qls
Landslide deposits

Qoa
Older alluvium
Chiefly gravel

Qm
Glacial moraine

QTb
Basalt

QTd
Diatomite

QTs
Weakly lithified sandstone and conglomerate

Tsu
Upper sedimentary unit
Shale, siltstone, sandstone, limestone, and conglomerate

Tr
Rhyolite plug or flow

Tolu
Upper nonwelded ash flow unit

Tql
Quartz latite

Tsl
Lower sedimentary unit
Mainly tuffaceous sedimentary rocks. Previously referred to as the Esmeralda Formation

Ta
Porphyritic andesite

Tvb
Volcanic breccia of andesitic or dacitic composition

SILVER PEAK AND PALMETTO MOUNTAINS

Qls
Landslide deposits

Qoa
Older alluvium

QTs4
Sedimentary unit 4
Weakly lithified conglomerate and tuffaceous rock

QTb
Basalt
Age 4.8 m.y. (million years) by K-Ar methods (Robinson and others, 1968, table 1, no. 7)

Ts3
Sedimentary unit 3
Tuff, shale, limestone, and conglomerate

Tfb
Upper welded ash flow
Age 6.1 m.y. by K-Ar method (Robinson and others, 1968, table 1, no. 5)

Tpb
Porphyritic basalt

Tpl / Ts
Porphyritic latite or trachyandesite
Tpl, porphyritic latite, K-Ar age is 5.9 m.y. (Robinson and others, 1968, no. 8)
Ts, sedimentary rocks; sandstone conglomerate, and tuff

Ta
Andesite
Probably in part intrusive

Tofu
Rhyolitic airfall tuff
Includes some rhyolitic lava flows and possibly some nonwelded ash flows. K-Ar age 6.0 m.y. (Robinson and others, 1968, table 1, no. 6)

Tr
Rhyolitic flows, domes, breccias, and intrusive masses

Ts2
Sedimentary unit 2 and welded ash flow
Ts2, Tuffaceous shale and sandstone. Age 12.7 m.y. by K-Ar method (Evernden and James, 1964)
Tsa2, Welded ash flow

Tvb
Volcanic breccia
Andesitic and dacitic(?) in composition

Ts1
Sedimentary unit 1

WEEPAH HILLS, LONE MOUNTAIN, ANGEL ISLAND AND NORTHEASTERN PART OF CLAYTON VALLEY

Qb
Basalt

Qoa
Older alluvium
Chiefly gravel

QTb
Basalt

Tr
Rhyolite plug or flow

Ts / Te / Tai
Esmeralda Formation and ash-flow deposits
Ts, Shale, siltstone, sandstone, and tuff
Te, Esmeralda Formation, shale, sandstone, and tuff. Includes some beds as young as 6.9 m.y. (Robinson and others, 1968, table 1, no. 13)
Tai, ash flow tuff

Taw
Welded ash flow

MONTE CRISTO RANGE AND CEDAR MOUNTAINS

Qoa
Older alluvium
Chiefly gravel

QTb
Basalt

Tg
Gilbert Andesite
An apparent anomalously old date of 15.1 m.y. was obtained from the Gilbert Andesite (table 3, this report)

Tr
Rhyolite plugs, domes, and flows

Ts
Shale, siltstone, sandstone, limestone, and tuff
Formerly referred to as Esmeralda Formation. Correlative rocks a few miles north of Esmeralda County are 10.7 and 11.5 m.y. old by K-Ar method (Evernden and others, 1964, p. 177, 180)

Tqb
Rhyolite breccia
Locally grades into welded ash flows; includes lower part of Esmeralda Formation of Ferguson and others (1953)

Taw
Rhyolitic to quartz latitic welded ash flows

Tac
Nonwelded ash flow

TONOPAH AREA

Qoa
Older alluvium
Chiefly gravel

QTb
Basalt
Olivine basalt

Tql
Quartz latite and felsite
Includes Brougher Dacite. Age 16.2 m.y. by K-Ar method (table 3, this report)

Ta
Andesite
Includes Divide Andesite

To
Oddie(?) Rhyolite

Ts
Siebert Tuff
Tuff, tuffaceous shale, and diatomite; locally includes some sandstone and conglomerate

Tfb
Fraction Breccia
Ash flows of dominantly rhyolitic composition. Correlated with rocks in Nye County which are dated at 17.5 m.y. by K-Ar method

Taf
Welded and nonwelded ash flows

GOLDFIELD HILLS, MONTEZUMA RANGE, CLAYTON RIDGE, AND MOUNT JACKSON RIDGE

Ql
Landslide deposits

Qs
Bedded clay and silt

QTb / QTmr
Malpais Basalt and Rabbit Spring Formation
QTb, basalt
QTmr, Malpais Basalt and Rabbit Spring Formation

Ttc
Thirsty Canyon Tuff
Spearhead Member in Nye County has K-Ar age of 7.5 m.y. (Noble and others, 1964, p. D25)

Tdr
Dark rhyolite or rhyodacite
Dominantly agglutinate

Tp
Pozo Formation
Dominantly conglomerate and subordinate sandstone, poorly consolidated

Tsc
Conglomerate and sandstone
Possibly correlative with Pozo Formation

Tr
Rhyolite plugs, domes, and flows

Tpl
Porphyritic latite or trachyandesite

Tm / Ts
Siebert Tuff and Mira Basalt
Ts, Siebert Tuff, dominantly tuffaceous sedimentary rocks of lacustrine origin
Tm, Mira Basalt; flow intertongues with Siebert Tuff

Airfall tuff and tuffaceous shale
Taf, airfall tuff and tuff breccia of rhyolitic composition
Tas, tuffaceous shale and intertonguing airfall tuff
Ta, andesite

Tc
Chispa Andesite

Taw
Welded ash flows
Includes Meda Rhyolite and dacite vitrophyre of Ransome (1909)
Age 21.1 m.y. by K-Ar method (this report, table 3)

Td
Dacite
Age 20.6 to 21.6 m.y. by K-Ar method

SLATE RIDGE AND SOUTHERN END OF COUNTY

QTb
Basalt

QTg
Weakly consolidated gravel and sand

Ttc
Thirsty Canyon Tuff
In map area includes only Spearhead and Trail Ridge Members. Spearhead Member in Nye County has K-Ar age of 7.5 m.y. (Noble and others 1964, p. D25)

Td
Dacite

Ttm
Ammonia Tanks Member of Timber Mountain Tuff
Welded ash flows. Ammonia Tanks Member in Nye County is 10.5 to 11.5 m.y. old by K-Ar methods (R. W. Kistler, written communication, 1963)

Taf
Airfall tuff and nonwelded ash flows
May include lower part of Ammonia Tanks Member of Timber Mountain Tuff

Tew
Welded ash flows
Age 22.8 m.y. by K-Ar method (Robinson and others, 1968, table 1, no. 14)

Tolf
Lower nonwelded ash flow
May include some airfall tuff

Tew
Lower welded ash flow
Age 21.5 m.y. by K-Ar method (Robinson and others, 1968, table 1, no. 12)

Tof
Lower nonwelded ash flow

Oligocene or Miocene

Tm
Milltown Andesite
Age 21.5 m.y. by K-Ar method (this report, table 3)

Tss
Sandstorm Formation

Tk
Kendall Tuff and latite of Ransome (1909a)

Tv
Vindicator Rhyolite
Includes Morena Rhyolite of Ransome (1909a)

PRE-TERTIARY SEQUENCE APPLIES TO ENTIRE COUNTY EXCEPT MILLER MOUNTAIN AND GRAPEVINE MOUNTAINS AS NOTED BELOW

UNCONFORMITY

Tjd
Dark aphanitic to medium-grained rocks of dioritic to andesitic composition

Tjr
Felsic aphanitic rhyolite and quartz porphyry dike rocks

JURASSIC TO TERTIARY

Jgr
Coarse-grained granitic rocks
Mainly biotite quartz monzonite but includes some granodiorite and monzonite. Also includes pegmatitic material in Mineral Ridge area

Lower and Middle Jurassic

Jd
Dunlap Formation
Red sandstone containing lenses of conglomerate and red shale

JURASSIC

UNCONFORMITY

Middle Triassic(?)

Te
Excelsior Formation

TRIASSIC(?)

UNCONFORMITY(?)

Lower Triassic

Tc
Candelaria Formation
Shale and siltstone

TRIASSIC

UNCONFORMITY

Pd
Diablo Formation
Dolomite, grit, and conglomerate

PERMIAN

MILLER MOUNTAIN AREA

Upper Cambrian

Middle and Upper Cambrian

Lower and Middle(?) Cambrian

Csh
Siliceous hornfels

Lower Cambrian

Cm
Marble
Possibly correlative with Mule Spring Limestone

Ch(?)
Harkless(?) Formation

Poleta(?) Formation
Siliceous and calc-silicate hornfels interbanded with marble

Cc
Campito Formation
Metamorphosed siltstone and quartzite

UNCONFORMITY

Op
Palmetto Formation
Dominantly black shale; locally contains abundant chert, limestone, and quartzite

Ce
Emigrant Formation
Mostly claystone in lower part, overlain by thin-bedded limestone with cherty layers

Cms
Mule Spring Limestone

Ch
Harkless Formation
Dominantly green siltstone, locally includes strata lithologically similar to and correlative with Saline Valley Formation as defined by Nelson (1962)

Cp
Poleta Formation
Mostly thick-bedded carbonate in lower part, overlain by green siltstone with limestone and quartzite interbeds

Ccm
Cca
Campito Formation
Ccm, *Montenegro Member, dominantly green siltstone*
Cca, *Andrews Mountain Member, dominantly dark-gray fine-grained quartzite*

ds
Deep Spring Formation
Dominantly well-bedded limestone and dolomite, subordinate dark quartzite

Reed Dolomite

wy
Wyman Formation
Dominantly siltstone containing thin limestone interbeds

GRAPEVINE MOUNTAINS

Ms
Shaly rocks
Contains impure carbonate lenses with Mississippian fossils

MISSISSIPPIAN

FAULT

Opn
Pogonip Group
Thin-bedded limestone with shaly interbeds

ORDOVICIAN

UNCONFORMITY(?)

Cn
Nopah Formation
Gray thick-bedded dolomite

CAMBRIAN

PRECAMBRIAN

Contact

High-angle fault
Dashed where approximately located, dotted where concealed. Bar and ball on downthrown side. Queried where doubtful

Low-angle fault or thrust
Dotted where concealed. Sawteeth on upper plate

Anticline
Showing crestline

Syncline
Showing troughline

Note: The Esmeralda Formation is herein restricted to include only the predominantly sedimentary upper unit as mapped by Ferguson and others (1953), and to exclude the Fraction Breccia from its lower part. The Spearhead was reduced in rank to a member of the Thirsty Canyon Tuff by Noble and others (1964)

Geology mapped 1960-63

GEOLOGIC MAP OF ESMERALDA COUNTY, NEVADA

By

John P. Albers and John H. Stewart

SCALE 1:250 000

5 0 5 10 15 20 MILES

5 0 5 10 15 20 KILOMETERS

CONTOUR INTERVALS 100 AND 200 FEET
DATUM IS MEAN SEA LEVEL

EXPLANATION

			SEDIMENTARY AND METASEDIMENTARY ROCKS		IGNEOUS AND META-IGNEOUS ROCKS
CENOZOIC	QUATERNARY	*Recent*	Qs	Dune sand	
			Qal	Alluvium	
			Qsc	Stream channel deposits (GREAT VALLEY)	Qrv — Recent volcanic: Qrv^r —rhyolite; Qrv^a —andesite; Qrv^b —basalt; Qrv^p —pyroclastic rocks
			Qf	Fan deposits (GREAT VALLEY)	
			Qb	Basin deposits (GREAT VALLEY)	
			Qst	Salt deposits	
			Ql	Quaternary lake deposits	
			Qg	Glacial deposits	
			Qt	Quaternary nonmarine terrace deposits	
		Pleistocene	Qm	Pleistocene marine and marine terrace deposits	Qpv — Pleistocene volcanic: Qpv^r —rhyolite; Qpv^a —andesite; Qpv^b —basalt; Qpv^p —pyroclastic rocks
			Qc	Pleistocene nonmarine	
			QP	Plio-Pleistocene nonmarine	Quaternary and/or Pliocene cinder cones
	TERTIARY	*Pliocene*	Pc	Undivided Pliocene nonmarine	
			Puc	Upper Pliocene nonmarine	
			Pu	Upper Pliocene marine	Pv — Pliocene volcanic: Pv^r —rhyolite; Pv^a —andesite; Pv^b —basalt; Pv^p —pyroclastic rocks
			Pmlc	Middle and/or lower Pliocene nonmarine	
			Pml	Middle and/or lower Pliocene marine	
		Miocene	Mc	Undivided Miocene nonmarine	
			Muc	Upper Miocene nonmarine	
			Mu	Upper Miocene marine	Mv — Miocene volcanic: Mv^r —rhyolite; Mv^a —andesite; Mv^b —basalt; Mv^p —pyroclastic rocks
			Mmc	Middle Miocene nonmarine	
			Mm	Middle Miocene marine	
			Ml	Lower Miocene marine	
		Oligocene	Φc	Oligocene nonmarine	Φv — Oligocene volcanic: $Φv^r$ —rhyolite; $Φv^a$ —andesite; $Φv^b$ —basalt; $Φv^p$ —pyroclastic rocks
			Φ	Oligocene marine	
		Eocene	Ec	Eocene nonmarine	Ev — Eocene volcanic: Ev^r —rhyolite; Ev^a —andesite; Ev^b —basalt; Ev^p —pyroclastic rocks
			E	Eocene marine	
		Paleocene	Epc	Paleocene nonmarine	
			Ep	Paleocene marine	

EXPLANATION CONT.

Paleocene

- Ep — Paleocene marine

Undivided

- QTc — Cenozoic nonmarine
- Tc — Tertiary nonmarine
- Tl — Tertiary lake deposits
- Tm — Tertiary marine

- QTv — Cenozoic volcanic: QTv^r —rhyolite; QTv^a —andesite; QTv^b —basalt; QTv^p —pyroclastic rocks
- Tgr — Tertiary granitic rocks
- Ti — Tertiary intrusive (hypabyssal) rocks: Ti^r –rhyolite; Ti^a –andesite; Ti^b –basalt
- Tv — Tertiary volcanic: Tv^r –rhyolite; Tv^a —andesite; Tv^b —basalt; Tv^p —pyroclastic rocks

MESOZOIC

CRETACEOUS

- K — Undivided Cretaceous marine
- Ku — Upper Cretaceous marine
- Kl — Lower Cretaceous marine

JURASSIC

- Jk — Knoxville Formation
- Ju — Upper Jurassic marine
- Jml — Middle and/or Lower Jurassic marine

TRIASSIC

- Ћ — Triassic marine

Franciscan Formation

- KJf — Franciscan Formation
- KJfv — Franciscan volcanic and metavolcanic rocks

- gr — Mesozoic granitic rocks: gr^a-granite and adamellite; gr^g-granodiorite; gr^t-tonalite and diorite
- bi — Mesozoic basic intrusive rocks
- ub — Mesozoic ultrabasic intrusive rocks
- JЋv — Jura-Trias metavolcanic rocks

UNDIVIDED

- m, ls — Pre-Cretaceous metamorphic rocks (ls = limestone or dolomite)
- ms — Pre-Cretaceous metasedimentary rocks
- P, ls — Paleozoic marine (ls = limestone or dolomite
- mv — Pre-Cretaceous metavolcanic rocks
- gr-m — Pre-Cenozoic granitic and metamorphic rocks
- Pv — Paleozoic metavolcanic rocks

PALEOZOIC

PERMIAN

- P — Permian marine
- Pv — Permian metavolcanic rocks

CARBONIFEROUS

- C — Undivided Carboniferous marine
- Cv — Carboniferous metavolcanic rocks
- CP — Pennsylvanian marine
- CM — Mississippian marine

DEVONIAN

- D — Devonian marine
- Dv — Devonian metavolcanic rocks
- Dv? — Devonian and pre-Devonian? metavolcanic rocks

SILURIAN

- S — Silurian marine
- pSs — Pre-Silurian metasedimentary rocks
- pS — Pre-Silurian metamorphic rocks
- pSv — Pre-Silurian metavolcanic rocks

ORDOVICIAN

- O — Ordovician marine

CAMBRIAN

- Є — Cambrian marine
- Є? — Cambrian – Precambrian marine
- pЄc — Precambrian igneous and metamorphic rock complex

PRECAMBRIAN

- pЄ — Undivided Precambrian metamorphic rocks; pЄg = gneiss, pЄs = schist
- pЄg — Undivided Precambrian granitic rocks
- lpЄ — Later Precambrian sedimentary and metamorphic rocks
- pЄan — Precambrian anorthosite
- epЄ — Earlier Precambrian metamorphic rocks

II. GEOLOGY

Precambrian and Paleozoic sediments, intruded by Jurassic quartz monzonite, are exposed in small areas in the northwestern and southwestern parts of the GRA. The remainder of the GRA is covered with Tertiary volcanic rocks or with Quaternary alluvium.

Some pre-Tertiary structure in the older rocks can be inferred from the structure seen in surrounding areas, but very little can be seen in the GRA. Bonnie Claire Flat in the middle of the GRA may be a shallow, northeast-trending downwarp of the Tertiary Timber Mountain Tuff. The Tertiary rocks are broken by a few east-west faults with substantial displacement, and by more numerous northeast-trending faults that appear to be subsidiary to the east-west ones.

1. PHYSIOGRAPHY

The northwestern part of the GRA, including most of WSA NV 050-0354, is an upland of mostly east- or northeast-trending ridges and valleys with a few hundred feet of relief, rising to an elevation of about 8,000 feet at Gold Mountain. Oriental Wash, which drains the northern part of the GRA into Death Valley, has an elevation of about 6,000 feet toward its eastern end and 4,000 feet at its western end where it drops off into Death Valley. Gold Mountain and the ridge a few miles northeast and southwest of it are the only areas in the GRA that have pinon pines. The rest has only sagebursh, greasewood and other desert vegetation.

Near the middle of the GRA Bonnie Claire Flat, at an elevation of about 4,000 feet, is a shallow closed valley. The western part drains westward through Grapevine Canyon into Death Valley.

Southeast of Bonnie Claire Flat is the north end of the Grapevine Mountains, which is rather closely dissected with relief of a few hundred feet and reaching to maximum elevations of about 7,000 feet. The east side of the Grapevine Mountains drains into Sarcobatus Flat, a closed valley at about 4,000 feet elevation. WSA NV 050-0355 covers all of the north end of the Grapevine Mountains and extends somewhat east into Sarcobatus Flat.

2. ROCK UNITS

The oldest rock unit in the GRA and in the region is the Precambrian Wyman Formation, which is mostly siltstone with some interbeds of limestone. It is the bottom unit of a thick series of Precambrian and Paleozoic sediments that underlies much of west-central Nevada and adjacent California. It is exposed only in small patches in the northwest corner of the

GRA and as a narrow band in the north-central part of the GRA near Gold Mountain (Albers and Stewart, 1972).

Very small outcrop areas of the Precambrian Reed Dolomite, which overlies the Wyman Formation, are exposed three miles east of Gold Mountain (Albers and Stewart, 1972). Other beds of a thick Cambrian sequence are not exposed in the GRA, though they are undoubtedly present. This series of sediments is essentially a transition zone between the dominantly carbonate facies of Paleozoic rocks to the east and the dominantly clastic facies to the west.

In the southwest corner of the GRA, mostly in California, undivided Paleozoic marine limestones and dolomites, probably eastern-facies rocks, are exposed (Strand, 1967). Just across the border in Nevada, south of Grapevine Canyon, is a small exposure area of Upper Cambrian Nopah Formation, Ordovician Pogonip Group, and probably-Mississippian shaly rocks (Albers and Stewart, 1972). All of these are eastern-facies units.

In the northwestern part of the GRA Jurassic quartz monzonite of the Sylvania pluton (Albers and Stewart, 1972) is rather widely exposed. A small area of the same rock is exposed near the area of Nopah-Pogonip sediments in the southwestern part of the GRA. This rock was intruded into the thick series of Precambrian/Paleozoic sediments. Mineralization in the area is thought to be related to this period of intrusions.

Most of the GRA is covered with Tertiary volcanic rocks or Quaternary alluvium, with none of the older rocks exposed.

The oldest Tertiary rocks appear to be rhyolite flows of Miocene age in the southeast corner of the GRA, in the north end of the Grapevine Mountains (Cornwall, 1972). Apparently overlying the rhyolites are dacites and andesites also of Miocene age, and overlying all of them is the Pliocene Timber Mountain Tuff (Cornwall, 1972). A little to the west and across the Nye County line into Esmeralda County, however, Albers and Stewart (1972) shows Timber Mountain Tuff overlain by dacite, the outcrop outlines of which fit with Cornwall's underlying dacite outlines in Nye County. The Timber Mountain Tuff covers the northwestern part of WSA NV 050-0355 and a great deal of WSA NV 050-0354.

In the southwest corner of the GRA, on the California side of the State boundary, Strand (1967) shows extensive Tertiary pyroclastics and basalts, probably the same as the Timber Mountain Tuff and the older dacites. He also shows small areas of Tertiary intrusive rocks, none of which are seen on the Nevada geologic maps (Albers and Stewart, 1972, and Cornwall, 1972).

Large areas of Quaternary alluvium are mapped in Oriental Wash near the north edge of the GRA, in Grapevine Canyon and Bonnie

Claire Flat near the middle, and in Sarcobatus Flat on the east side of the GRA.

3. STRUCTURAL GEOLOGY AND TECTONICS

Structure in the pre-Tertiary rocks in the GRA is essentially unknown because the exposures of these units are so limited. Regionally the Precambrian and Paleozoic sediments are folded, with fold axes trending about east-west according to Albers and Stewart's (1972) oroflexural pattern. The Jurassic intrusives tend to be elongated in the direction of the fold axes. Just south of Grapevine Canyon near the state boundary, the Cambrian and Ordovician sediments are in thrust contact over the Mississippian shales. Albers and Stewart (1972) consider this to be part of a major thrust fault mapped twenty miles to the northwest.

The most prominent structure in the GRA is the Furnace Creek fault zone, which strikes northwest, parallel to the California-Nevada boundary and about five miles west of the boundary. This right-lateral strike-slip fault has at least several miles of displacement (Strand, 1967) and probably several tens of miles of displacement. Displacement on it began in Tertiary time and it has been active until fairly recently.

The Timber Mountain Formation in WSA NV 050-0354 northwest of Bonnie Claire Flat strikes northeast and dips southeast, and is cut by three major east-striking faults and numerous northeast-striking faults that make off from the east-striking ones. In WSA NV 050-0355, south of Bonnie Claire Flat, the Timber Mountain strikes northeast and dips northwest (Albers and Stewart, 1972), suggesting that there is a shallow northeast-trending fold in these Tertiary rocks.

4. PALEONTOLOGY

With the exception of limited areas of late Precambrian - early Cambrian rocks (equivalent of Deep Springs and Campito formations; Nelson, 1962) the Grapevine Canyon GRA is not likely to contain any paleontological resources. No fossil localities are known to have been recorded from this area.

5. HISTORICAL GEOLOGY

A thick sequence of sediments deposited between Late Precambrian and about Middle Paleozoic was presumably folded early in the Mesozoic. In the Jurassic one or more quartz monzonite bodies were intruded into the folded sediments, with the fold axes exerting some control over the intrusion so that the resulting plutons tend to be elongated in the direction of

the fold axial trend. Mineralization of the sediments and the plutonic rocks resulted from this epoch of intrustion.

After a long period of erosion, the very extensive Timber Mountain Tuff was deposited during the Late Miocene on the erosion surface cut on the sediments and intrusives. Flow rocks of somewhat more basic composition preceded the Timber Mountain Tuff in some places, and similar rocks overlie it elsewhere (Albers and Stewart, 1972, and Cornwall, 1972). The total thickness of these rocks may be on the order of 2,000 feet. The Tertiary rocks and broad expanses of Quaternary alluvium in the valleys cover the older rocks throughout most of the GRA and on nearly all of both WSAs.

III. ENERGY AND MINERAL RESOURCES

A. METALLIC MINERAL RESOURCES

1. Known Mineral Deposits

In the north-central part of the GRA is the Gold Mountain or Tokop district, where gold veins occur in intrusive rocks and adjacent metamorphosed Precambrian sediments. The district has recorded production of only $4,000 according to Albers and Stewart (1972) who mention that a small quantity of tungsten has been produced from the district.

Six miles north of Gold Mountain is the Hornsilver (Gold Point) district, which probably produced about one million dollars in gold and silver (Albers and Stewart, 1972). This would be about ten million dollars at prices in the early 1980s.

2. Known Prospects, Mineral Occurrences and Mineralized Areas

In the middle of the north edge of the Ubehebe Crater 15-minute topographic quadrangle, just below the edge of the map there are several prospect symbols and one shaft symbol (#1 on the Metallic Minerals Occurrence and Land Classification Map). These are apparently within WSA NV 050-0354.

In the northwest corner of the GRA at the northwest point of WSA NV 050-0354 is a cluster of silver prospects, one of which is known as Silver Mountain (Albers and Stewart, 1972) (#2). As Albers has plotted the prospects, two of them are within the WSA boundary. The Ubehebe Crater 15-minute topographic quadrangle shows only a single very tight cluster of diggings, around which the WSA boundary was apparently drawn to exclude them from the WSA.

In the southwest corner of WSA NV 050-0355, about in Sec. 31, T 9 S, R 43 E (projected), Albers and Stewart (1972) show a prospect symbol with no symbol to designate the commodity (#3). The Bonnie Claire SW 7 1/2-minute topographic quadrangle shows no prospect symbol in this vicinity, although a jeep trail leads to about the proper place with no sign of any other reason for the existence of the trail.

No other metallic mineral prospects, mineral occurrences or mineralized areas are known in either WSA or in the GRA. However, small mines and prospects are found at rather close intervals nearly everywhere that the Paleozoic sediments and Jurassic intrusives are exposed for twenty miles to the north (Albers and Stewart, 1972).

There are no outcrops of pre-Tertiary rocks for twenty and more miles to the east (Cornwall, 1972) but to the south there are Paleozoic sediments without intrusive bodies exposed (Cornwall, 1972 and Streitz and Stinson, 1974).

3. Mining Claims

There are patented claims in the north-central part of the GRA in the Gold Mountain district. Some of them plot very close to the WSA boundary.

There are a great many unpatented claims in the northern part of the GRA. Most of these are outside WSA NV 050-0354, but one group extends southward a couple of miles into the northern part of the WSA. Some of the claims in this group appear to cover the diggings shown on the Ubehebe Craters topographic quadrangle (#1), but most of the claims are plotted farther west. It is possible that the plot of the claims is erroneous, because this is an unsurveyed township that is complicated by having an extra half-township just north of it. If the plot of claims were shifted about half a township eastward, most of the claims would be in the vicinity of the old workings and a very few scattered claims would lie farther east. However, as plotted the claims apparently cover an outcrop area of Jurassic quartz monzonite, so there is reasonable justification for their positions -- all known mineralization is in this rock or other pre-Tertiary rocks. Whatever the plotting, there are several sections here with unpatented claims that lie within the WSA.

Near the eastern point of WSA NV 050-0354 are a couple of claims that lie about on the boundary of the WSA.

In WSA NV 050-0355 there are claims in two quarter sections in the northwest center of the WSA, and claims in one-quarter section near the south-central border.

4. Mineral Deposit Types

The gold occurrences in the Gold Mountain district are in quartz veins with some silver and base metals, in granitic rocks of the Sylvania pluton and in adjacent metamorphosed shale and limestone of the Wyman Formation. At Silver Mountain in the western part of the GRA, the Wyman Formation is intruded by the Sylvania pluton, and presumably the veins here are similar to those of Gold Mountain but with higher silver-gold ratios (Albers and Stewart, 1972).

Nothing is known of the prospect in the southwest corner of WSA NV 050-0344, but a small area of granitic rocks, perhaps part of the Sylvania pluton, is exposed here.

5. Mineral Economics

The veins that have been mined or prospected in the GRA are evidently either too small or too low-grade to have permitted substantial mining at any time in the past hundred years, which suggests that they are not likely to be mineable in the future.

The major use of gold is for storing wealth. It is no longer used for coinage because of monetary problems, but many gold "coins" are struck each year for sale simply as known quantities of gold that the buyer can keep or dispose of relatively easily. The greatest other use of gold is in jewelry, another form of stored wealth. In recent years industrial applications have become increasingly important, especially as a conductor in electronic instrumentation. In the United States and some other countries gold is measured in troy ounces that weigh 31.1 grams -- twelve of which make one troy pound. Annual world production is about 40 million ounces per year, of which the United States produces somewhat more than one million ounces, less than one-fourth of its consumption, while the Republic of South Africa is by far the largest producer at more than 20 million ounces per year. World production is expected to increase through the 1980s. For many years the price was fixed by the United States at $35 per ounce, but after deregulation the price rose to a high of more than $800 per ounce and then dropped to the neighborhood of $400 per ounce. At the end of 1982 the price was $460.50 per ounce.

The major uses of silver are in photographic film, sterlingware, and increasingly in electrical contacts and conductors. It is also widely used for storage of wealth in the form of jewelry, "coins" or bullion. Like gold it is commonly measured in troy ounces, which weigh 31.1 grand grams, twelve of which make one troy pound. World production is about 350 million ounces per year, of which the United States produces about one-tenth, while it uses more than one-third of world production. About two-thirds of all silver is produced as a byproduct in the mining of other metals, so the supply cannot readily adjust to demand. It is a strategic metal. Demand is expected to increase in the next decades because of growing industrial use. At the end of 1982 the price of silver was $11.70 per ounce.

More than half of all tungsten used is in the form of tungsten carbide, a hard and durable material used in cutting tools, wear-resistant surfaces and hard-faced welding rods. Lesser quantities are used in alloy steels, in light bulb filaments, and in chemicals. World production of tungsten is nearly 100 million pounds annually, of which the United States produces somewhat

more than six million pounds, while using more than 23 million pounds. The shortfall is imported from Canada, Bolivia, Thailand and Mainland China, as well as other countries. Tungsten is a strategic and critical metal. United States demand is projected to about double by the year 2000, and most of the additional supply will probably be imported, because large reserves are in countries in which profitability is not a factor -- they need foreign exchange, and therefore sell at a price that few domestic mines can match. Tungsten prices F.O.B. mine are quoted for "short ton units", which are the equivalent of 20 pounds of contained tungsten. At the end of 1982 the price of tungsten was about $80 per short ton unit.

B. NONMETALLIC MINERAL RESOURCES

1. Known Mineral Deposits

No nonmetallic mineral deposits are known in the Grapevine Canyon GRA.

2. Known Prospects, Mineral Occurrences and Mineralized Areas

The large expanses mapped as Quaternary alluvium that are included in WSAs NV 050-0354 and 050-0355 contain, by definition, sand and gravel.

No other nonmetallic mineral prospects, occurrences or mineralized areas are known in either WSA.

3. Mining Claims, Leases and Material Sites

No mining claims can be identified as having been located for nonmetallic minerals. There are no mineral leases in either WSA. No material sites are known in either WSA, although there are probably old borrow pits along State Highway 72.

4. Mineral Deposit Types

The sand and gravel of the Quaternary alluvium undoubtedly varies in quality from place to place. Some of it might be high quality, suitable for use as an aggregate, but nearly all of it is suitable at least for fill material.

5. Mineral Economics

Whatever the quality of sand and gravel in this area, the material is likely to have a market only when a construction project is under way nearby.

The most common use of sand and gravel is as "aggregate" -- as part of a mixture with cement to form concrete. The second largest use is as road base, or fill. About 97 percent of all sand and gravel used in the United States is in these applications in the construction industry. The remaining three percent is used for glassmaking, foundry sands, abrasives, filters and similar applications. The United States uses nearly one billion tons of sand and gravel annually, all of it produced domestically except for a very small tonnage of sand that is imported for highly specialized uses. Since construction is by far the greatest user of sand and gravel, the largest production is near sites of intensive construction, usually metropolitan areas. Since sand and gravel are extremely common nearly everywhere, the price is generally very low and mines are very close to the point of consumption -- within a few miles as a rule. However, for some applications such as high-quality concrete there are quite high specifications for sand and gravel, and acceptable material must be hauled twenty miles and more. Demand for sand and gravel fluctuates with activity in the construction industry, and is relatively low during the recession of the early 1980s. Demand is expected to increase by about one-third by the year 2000. In the early 1980s the price of sand and gravel F.O.B. plant averaged about $2.50 per ton but varied widely depending upon quality and to some extent upon location.

C. ENERGY RESOURCES

Uranium and Thorium Resources

1. Known Mineral Deposits

There are no known uranium or thorium deposits in the WSAs or GRA.

2. Known Prospects, Mineral Occurrences and Mineralized Areas

Several radioactive occurrences have been identified in and near the northern part of the GRA (see Uranium Land Classification and Mineral Occurrence Map). One of these occurrences, the Independence group, is probably in WSA NV 050-0354. All of the occurrences are in quartz monzonite or the Precambrian Wyman Formation in the Tokop mining district (Garside, 1973). The occurrences are tabulated below:

Name	Location	Occurrence
Old Ingalls mine	T 7 S, R 40 E - Tule Canyon area	Presence of uranium reported at mine.
Tule Canyon Placers	T 7 S, R 40 E	Heavy mineral fraction of gravel contains uranothorite, monazite, xenotime and euxenite
Tule Royal group (Nos. 1-6)	T 8 S, R 41 E East side Tule Canyon	Anomalous radioactivity associated with limonitic patches in granite adjacent to 2 foot wide quartz vein.
Name Unknown	SW 1/4, Sec. 23, and NW 1/4, Sec. 26, T 8 S, R 40 E	Autunite occurs along fault in Precambrian Wyman Formation
Atlas, Moonstone, Annex, and Ajax No. 1 claims	Sec. 12(?), T 7 S, R 41 E	Anomalous radioactivity associated with Cu-Pb-Zn-bearing quartz veins in granite
Checkmate No. 1 claim	37° 18' 14" north latitude, 117° 20' 50" west longitude 3.5 miles southeast of Gold Point	Radioactivity associated with foot wall side of oxidized "iron dike" which cuts limestone of Wyman Formation

Independence group (nos. 1-6)	37° 14' north latitude 117° 19' west longitude Willow Spring area(?)	Radioactivity associated with gouge zones, containing iron oxides and copper carbonates along faults in limestone of Wyman Formation
Susan group (nos. 1-6)	NW 1/4, T 8 S, R 42 E	Anomalous radioactivity in pods and stringers along contacts of pegmatite dike and granitic rocks
Randolph mine	T 8 S, R 42 E	Anomalous radioactivity associated with Kaolinized shear zone in quartz monzonite, autunite was reported
Red Rock claims (nos. 1 and 2)	Sec. 2(?), T 8 S, R 42 E	Autunite, azurite, malachite, siderite and iron oxides occur along a brecciated shear zone in limestone of the Wyman Formation

In addition to these occurrences, radioactivity has been reported from prospects in the Bullfrog mining district (Sec. 26, T 11 S, R 46 E and Sec. 15 and 16, T 12 S, R 46 E) east of WSA NV 050-0355. At these locations anomalous radioactivity is associated with faults and fractures in rhyolitic and flow tuffs. The relationship of the uranium

occurrences to precious metal mineralization in the district is unknown (Garside, 1973).

3. Mining Claims

There are no known uranium or thorium claims in the WSA or GRA. There are numerous unpatented claims in the GRA, but it is unknown if any of these were staked for uranium or thorium.

4. Mineral Deposit Types

Uranium and thorium deposit types cannot be discussed due to the lack of deposits of these elements in the GRA and WSA.

5. Mineral Economics

Uranium and thorium are probably of no economic value in the WSAs or GRA. Known occurrences of these metals are probably too small and low grade to be economically mined.

Uranium in its enriched form is used primarily as fuel for nuclear reactors, with lesser amounts being used in the manufacture of atomic weapons and materials which are used for medical radiation treatments. Annual western world production of uranium concentrates totaled approximately 57,000 tons in 1981, and the United States was responsible for about 30 percent of this total, making the United States the largest single producer of uranium (American Bureau of Metal Statistics, 1982). The United States ranks second behind Australia in uranium resources based on a production cost of $25/pound or less. United States uranium demand is growing at a much slower rate than was forecast in the late 1970s, because the number of new reactors scheduled for construction has declined sharply since the accident at the Three Mile Island Nuclear Plant in March, 1979. Current and future supplies were seen to exceed future demand by a significant margin and spot prices of uranium fell from $40/pound to $25/pound from January, 1980 to January, 1981 (Mining Journal, July 24, 1981). At present the outlook for the United States uranium industry is bleak. Low prices and overproduction in the industry have resulted in the closures of numerous uranium mines and mills and reduced production at properties which have remained in operation. The price of uranium at the end of 1982 was $19.75/pound of concentrate.

Thorium is used in the manufacture of incandescent gas mantles, welding rods, refractories, as fuel for nuclear power reactors and as an alloying agent. The principal

source of thorium is monazite which is recovered as a by-product of titanium, zirconium and rare earth recovery from beach sands. Although monazite is produced from Florida beach sands, thorium products are not produced from monazite in the United States. Consequently, thorium products used in the United States come from imports, primarily from France and Canada, and industry and government stocks. Estimated United States consumption of thorium in 1980 was 33 tons, most of which was used in incandescent lamp mantles and refractories (Kirk, 1980b). Use of thorium as nuclear fuel is relatively small at present, because only two commercial thorium-fueled reactors are in operation. Annual United States demand for thorium is projected at 155 tons by 2000 (Kirk, 1980a). Most of this growth is forecast to occur in nuclear power reactor usage, assuming that six to ten thorium-fueled reactors are on line by that time. The United States and the rest of the world are in a favorable position with regard to adequacy of thorium reserves. The United States has reserves estimated at 218,000 tons of ThO_2 in stream and beach placers, veins and carbonatite deposits (Kirk, 1982); and probable cumulative demand in the United States as of 2000 is estimated at only 1,800 tons (Kirk, 1980b). The price of thorium oxide at the end of 1981 was $16.45 per pound.

Oil and Gas Resources

There are no known oil and gas deposits or oil seeps, nor have there been any exploration wells drilled in the GRA or the bordering areas.

There are no Federal oil and gas leases in the GRA or vicinity. No serious exploration for petroleum has ever been done in this part of the Basin and Range province due to the absence of source rocks.

Geothermal Resources

1. Known Geothermal Deposits

   There are no known geothermal deposits in the GRA.

2. Known Prospects, Geothermal Occurrences, and Geothermal Areas

   The known prospects and occurrences are: Locality #1 (on Geothermal Mineral Occurrence and Land Classification Map) is an unnamed 77°F spring just outside the WSA, and within the GRA in Nevada; a 72°F water well (#2) with a 203-foot depth at Scottys Junction, Nevada; and the 100°F Grapevine

Spring (#3) in Death Valley, California, just one mile outside the GRA (Garside and Schilling, 1979, 1980).

3. Geothermal Leases

There are no recorded geothermal leases in the GRA.

4. Geothermal Deposit Types

Geothermal resources are hot water and/or steam which occurs in subsurface reservoirs or at the surface as springs. The temperature of a resource may be about 70°F (or just above average ambient air temperature) to well above 400°F in the Basin and Range province.

The reservoirs may be individual faults, intricate fault-fracture systems, or rock units having intergranular permeability -- or a combination of these. Deep-seated normal faults are believed to be the main conduits for the thermal waters rising from thousands of feet below in the earth's crust.

The higher temperature and larger capacity resources in the Basin and Range are generally hydrothermal convective systems. The lower temperature reservoirs may be individual faults bearing thermal water or lower pressured, permeable rock units fed by faults or fault systems. Reservoirs are present from the surface to over 10,000 feet in depth.

5. Geothermal Economics

Geothermal resources are utilized in the form of hot water or steam normally captured by means of drilling wells to a depth of a few feet to over 10,000 feet in depth. The fluid temperature, sustained flow rate and water chemistry characteristics of a geothermal reservoir determine the depth to which it will be economically feasible to drill and develop each site.

Higher temperature resources (above 350°F) are currently being used to generate electrical power in Utah and California, and in a number of foreign countries. As fuel costs rise and technology improves, the lower temperature limit for power will decrease appreciably -- especially for remote sites.

All thermal waters can be beneficially used in some way, including fish farming (68°F), warm water for year around mining in cold climates (86°F), residential space heating (122°F), greenhouses by space heating (176°F), drying of

vegetables (212°F), extraction of salts by evaporation and crystallization (266°F), and drying of diatomaceous earth (338°F).

Unlike most mineral commodities remoteness of resource location is not a drawback. Domestic and commercial use of natural thermal springs and shallow wells in the Basin and Range province is a historical fact for over 100 years.

Development and maintenance of a resource for beneficial use may mean no dollars or hundreds of millions of dollars, depending on the resource characteristics, the end use and the intensity or level of use.

D. OTHER GEOLOGICAL RESOURCES

No other geological resources are known in the GRA. There is no reason to expect any coal, oil shale or tar sand resources.

E. STRATEGIC AND CRITICAL MINERALS AND METALS

A list of strategic and critical minerals and metals provided by the BLM was used as a guideline for the discussion of strategic and critical materials in this report.

The Stockpile Report to the Congress, October 1981-March 1982, states that the term "strategic and critical materials" refers to materials that would be needed to supply the industrial military and essential civilian needs of the United States during a national emergency and are not found or produced in the United States in sufficient quantities to meet such need. The report does not define a distinction between strategic and critical minerals.

Tungsten, a strategic and critical metal, occurs in the Silver Mountain prospect at the northwestern corner of WSA NV 050-0354; some of the prospects in this vicinity, which may be silver prospects, are within the WSA.

IV. LAND CLASSIFICATION FOR G-E-M RESOURCES POTENTIAL

The only geologic maps available are those of Albers and Stewart (1972), Cornwall (1972) and Strand (1967), all of which are at a scale of 1:250,000. Considering their scales, they are good geologic maps. Virtually all the data on mineral occurrences comes from Albers and Stewart (1972), whose descriptions are very brief. The quantity and quality of the geological coverage are fairly good, particularly in view of the fact that both WSAs are almost completely covered by Tertiary volcanics or Quaternary alluvium, which in this region have very little potential for mineral deposits -- the important geology is that of the pre-Tertiary rocks which are but little exposed. The quantity and quality of data on mineral occurrences are minimal. The overall level of confidence in the data available is moderate.

Land classification areas are numbered starting with the number 1 in each category of resources. Metallic mineral land classification areas have the prefix M, 3.g. M1-4D. Uranium and thorium areas have the prefix U. Nonmetallic mineral areas have the prefix N. Oil and gas areas have the prefix OG. Geothermal areas have the prefix G. Sodium and potassium areas have the prefix S. The saleable resources are classified under the nonmetallic mineral resource section. Both the Classification Scheme, numbers 1 through 4, and the Level of Confidence Scheme, letters A, B, C, and D, as supplied by the BLM are included as attachments to this report. These schemes were used as strict guidelines in developing the mineral classification areas used in this report.

Land classifications have been made here only for the areas that encompass segments of the WSAs. Where data outside a WSA has been used in establishing a classification area within a WSA, then at least a part of the surrounding area may also be included for clarification. The classified areas are shown on the 1:250,000 mylars or the prints of those that accompany each copy of this report.

In connection with nonmetallic mineral classification, it should be noted that in all instances areas mapped as alluvium are classified as having moderate favorability for sand and gravel, with moderate confidence, since alluvium is by definition sand and gravel. All areas mapped as principally limestone or dolomite have a similar classification since these rocks are usable for cement or lime production. All areas mapped as other rock, if they do not have specific reason for a different classification, are classified as having low favorability, with low confidence, for nonmetallic mineral potential, since any mineral material can at least be used in construction applications.

1. LOCATABLE RESOURCES

a. Metallic Minerals

WSA NV 050-0354

M1-4C. This classification area covers about the northern one-third of the WSA. At its west end is the Silver Mountain mine, outside the WSA, and two prospects perhaps a mile or more within the WSA. All of them are in either Precambrian and Paleozoic sediments or the Jurassic quartz monzonite that intrudes them. At its east end and just outside the WSA is the main area of the Gold Mountain district where gold and a small amount of tungsten (a strategic and critical metal) have been produced from pre-Tertiary rocks. Between them are at least two prospects in quartz monzonite, and numerous unpatented claims, all within the WSA. The presence of productive mines and scattered prospects are the reason for the high favorability classification, while the level of confidence in this classification is only moderate because the older rocks that can be expected to host any mineralization are mostly covered by Tertiary volcanics. The southern boundary of the classification area is drawn arbitrarily to include known occurrences of metallic minerals. Its position is, in fact, unknown except that as the area is defined, it cannot lie farther north than it is presently drawn, and may lie farther south.

M2-2B. This classification area covers the remainder of the WSA and all of WSA NV 050-0355. In the northern part of the GRA and for many miles northward wherever Paleozoic rocks are exposed they are seen to be intruded at close intervals by Jurassic plutons; they also are seen to have metallic mineral mines or occurrences, mostly gold-silver but some tungsten and base metals, at relatively close intervals. South of the GRA for many miles there are few exposures of Paleozoic rocks except in the east wall of Death Valley, but where they are exposed these rocks have few or no Jurassic intrusive rocks and also very few metallic mineral mines or occurrences. The implication is that somewhere in or just south of the GRA is the southern boundary of the pre-Tertiary terrane in which intrusives and mineralization occurrences related to them are numerous. The pre-Tertiary terrane farther south has few or no intrusives and few or no mineralized occurrences. Albers and Stewart (1972) map Jurassic quartz monzonite at the south edge of the GRA, so the dividing line between the two terranes apparently lies somewhat south of the GRA. By this line of reasoning then, the WSA is underlain by Paleozoic rocks with intrusive bodies; and by analogy with similar areas that are exposed farther north, metallic mineral occurrences -- precious metals, base metals and tungsten -- should be relatively numerous. This is the reason for the classification as low

favorability for metallic mineral resources, and the low level of confidence. It is based entirely on geological reasoning.

WSA NV 050-0355

M2-2B. This classification area covers all of the WSA. The reasoning behind the classification is given above, under WSA NV 050-0354.

b. Uranium and Thorium

WSA NV 050-0354 and WSA NV 050-0355

U1-2B. This land classification includes the northwest and central parts of WSA NV 050-0354, the central part of WSA NV 050-0355 and most of the northern and southern margins of the GRA. The northern part of the area is covered by Mesozoic granitic intrusives and Precambrian-Cambrian sedimentary rocks, while the southern part, including most of WSA NV 050-0354 and WSA NV 050-0355, is covered by Tertiary ash flow tuffs and rhyolites. The areas have low favorability at a low level of confidence for fracture-filled, caldera-related or intrusive contact uranium deposits. Intrusive contact deposits may occur in the northern part of the area where Mesozoic granitic rocks intrude Precambrian sediments. Radioactive occurrences in fractures in the Wyman Formation, mentioned above, are probably of this type. Fracture-filled deposits may occur in the granitic rocks or in Tertiary tuffs and rhyolites in the southern part of the area. Uranium leached from these rocks and transported by ground water may be deposited in fractures in these units. Uranium occurrences in rhyolitic tuffs in the Bullfrog Hills southeast of WSA NV 050-0355 are probably of this type, and may be related to development of a caldera in that area which was identified by Cornwall (1972). Several sediment samples associated with granitic rocks and Tertiary volcanic rocks in the northern part of the GRA had anomalous uranium concentrations (4-10 ppm) (Oak Ridge Gaseous Diffusion Plant, 1981), indicating that these rock units are potential uranium sources.

The northern part of the area has low favorability for thorium deposits at a low confidence level in pegmatites associated with the Mesozoic granitic intrusives.

U2-2B. This land classification covers the eastern part of WSA NV 050-0354, the eastern and western margins of WSA NV 050-0355, and parts of the western, northern, and eastern portions of the GRA. These areas are covered by Quaternary alluvium, and they have low favorability at a low confidence level for uranium in epigenetic sandstone

deposits. Mesozoic granitic intrusives and Tertiary volcanics are possible sources of uranium, which can be leached by ground water and deposited in reduced zones in the permeable alluvium.

The northern part of WSA NV 050-0354 has low favorability at a low confidence level for thorium deposits in placer accumulations of resistate minerals such as monazite. The granitic intrusives and pegmatites are possible sources for thorium-bearing heavy minerals in the area. An occurrence of this type has been noted in Tule Canyon, just north of the GRA, indicating that the granitic rocks are a potential thorium source in the area. There is probably very low favorability for thorium deposits in the southeastern portions of the WSAs or GRA because the potential thorium source rocks are buried by Tertiary volcanics and probably have not been a major source of sediment in the alluvial deposits.

c. Nonmetallic Minerals

WSA NV 050-0354

N1-3C. This classification area covers a small part of the north edge of the WSA. The Quaternary alluvium that is mapped here, by definition contains sand and gravel, which is the reason for the moderately favorable classification for this commodity. The quality of the sand and gravel at any given point is unknown, so the level of confidence is only moderate.

N2-3C. This classification area covers much of the eastern and southern parts of the WSA where Quaternary alluvium is mapped. The rationale for the classification and level of confidence is the same as for N1-3C.

N3-2B. This classification area covers the remainder of the WSA -- about half of it. No nonmetallic mineral occurrences are known in the pre-Tertiary and Tertiary rocks that are exposed here. However, any mineral material can become an economically mineable nonmetallic mineral if a use can be found that takes advantage of the particular chemical or physical properties of that material. This is the reason for the low favorability and the low level of confidence.

WSA NV 050-0355

N2-3C. This classification area covers the eastern and western parts of the WSA where Quaternary alluvium is mapped. The rationale for the classification and level of confidence is given above under WSA NV 050-0354.

N4-2B. This classification area covers the remaining half of the WSA where pre-Tertiary and Tertiary rocks are mapped. The rationale for the classification and the level of confidence are the same as for N3-2B, presented above under WSA NV 050-0354.

2. LEASABLE RESOURCES

a. Oil and Gas

WSAs NV 050-0354 and NV 050-0355

OG1-1D. The two WSAs are underlain by a thick section of Tertiary volcanics and a thin veneer of valley alluvium, which undoubtedly covers an extension of the volcanics. Relatively extensive outcrops of Tertiary/Jurassic granitic intrusives are also present in WSA 050-0354, and Triassic age volcanic section is present at the south end of WSA 050-0355. Metamorphosed rocks of Paleozoic age have been mapped elsewhere in the GRA.

It is obvious that a section favorable for the generation and entrapment of hydrocarbons does not exist beneath the WSAs.

b. Geothermal

WSAs NV 050-0354 and NV 050-0355

G1-3A. The WSAs are in a part of the Basin and Range where deep-seated normal faults are known to be conduits for Late Cenozoic volcanics and thermal waters (#1, #2 and #3). The WSAs are almost entirely underlain by Tertiary volcanics which are cut by numerous regional-scale normal faults. Both WSAs have Quaternary age volcanics present in outcrop.

These factors support some favorability. The area is very remote, and few or no wells have been drilled for water or other purposes which might intersect thermal waters.

c. Sodium and Potassium

WSAs NV 050-0354 and NV 050-0355

S1-1D. This classification applies to the entire WSA. There is no indication of favorability for the accumulation of resources of sodium and potassium. No map is presented for sodium and potassium.

3. SALEABLE RESOURCES

Saleable resources have been considered in the section on Nonmetallic Minerals.

V. RECOMMENDATIONS FOR ADDITIONAL WORK

No additional work is recommended for the Grapevine Canyon GRA.

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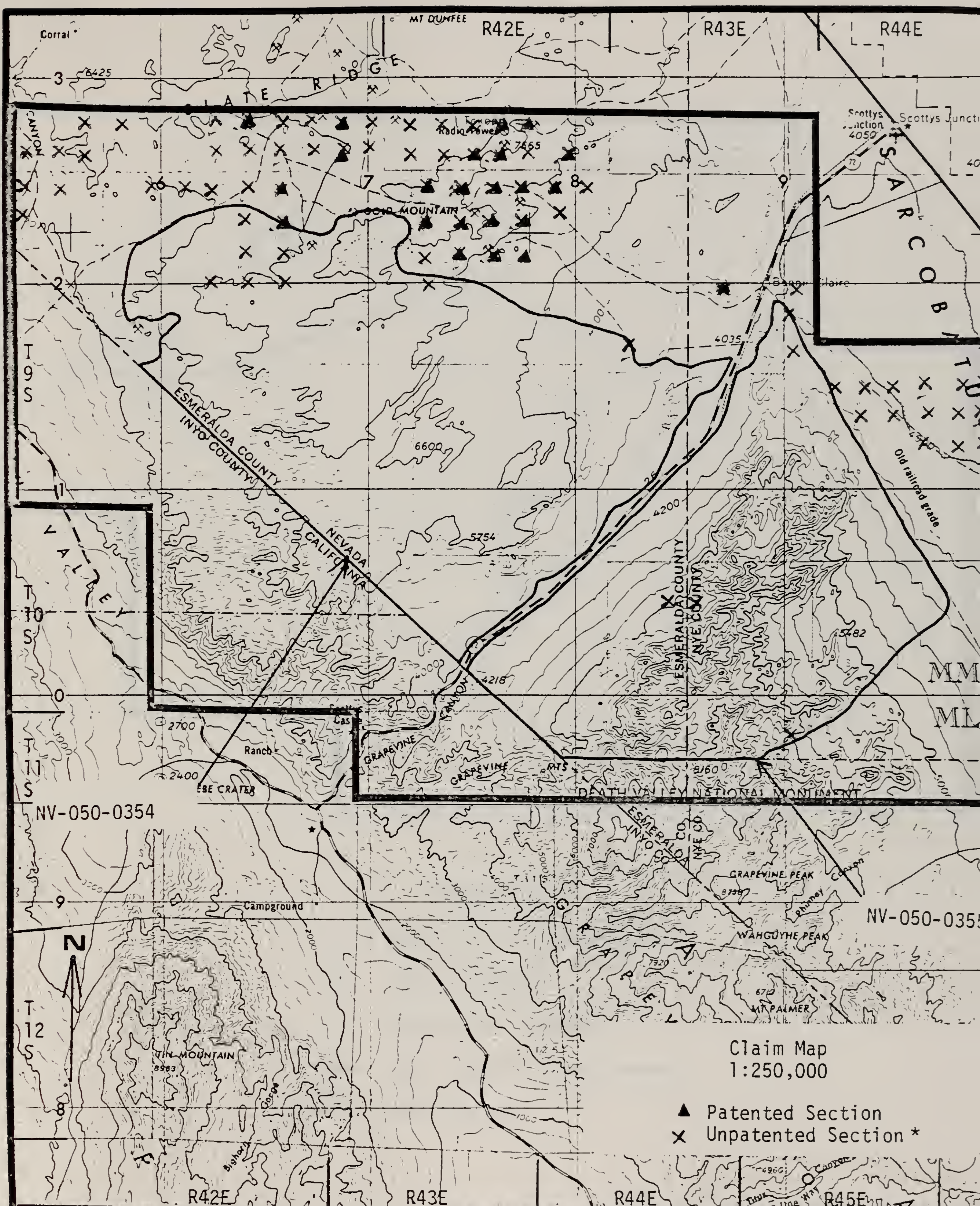
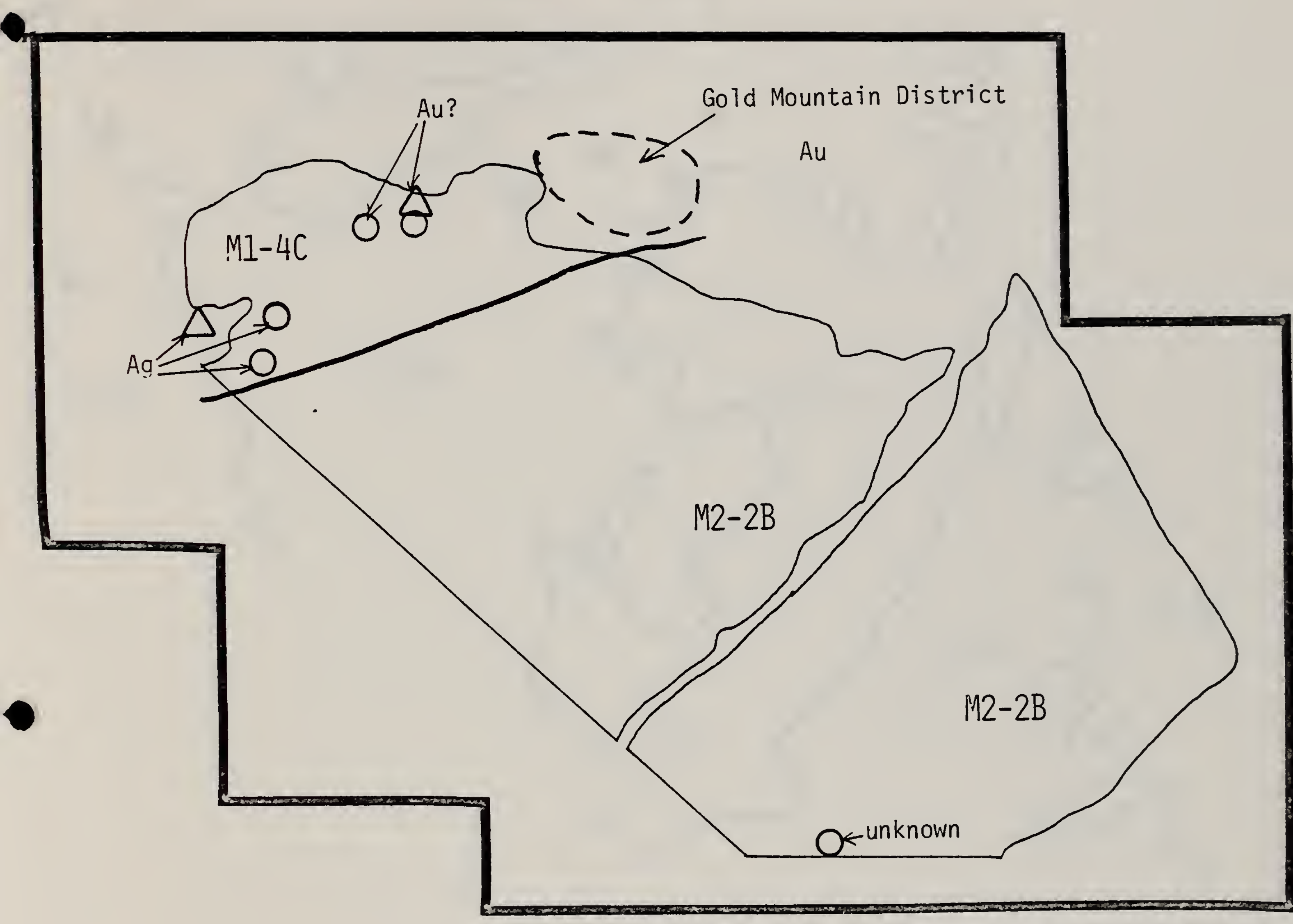


*X denote one or more claims per section



EXPLANATION

- - - Mining District, commodity

△ Mine, commodity

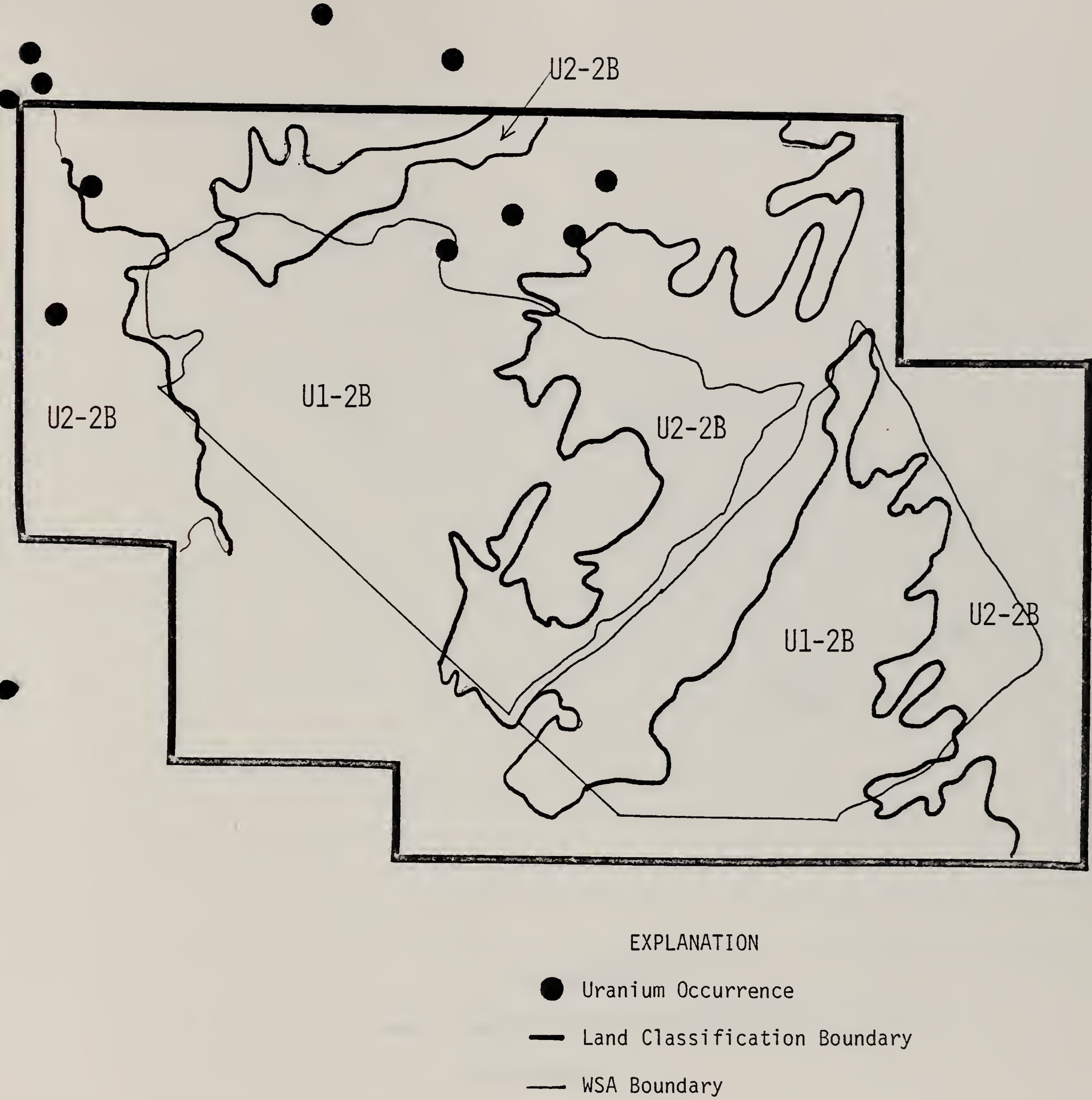
○ Occurrence, commodity

▬ Land Classification Boundary

— WSA Boundary

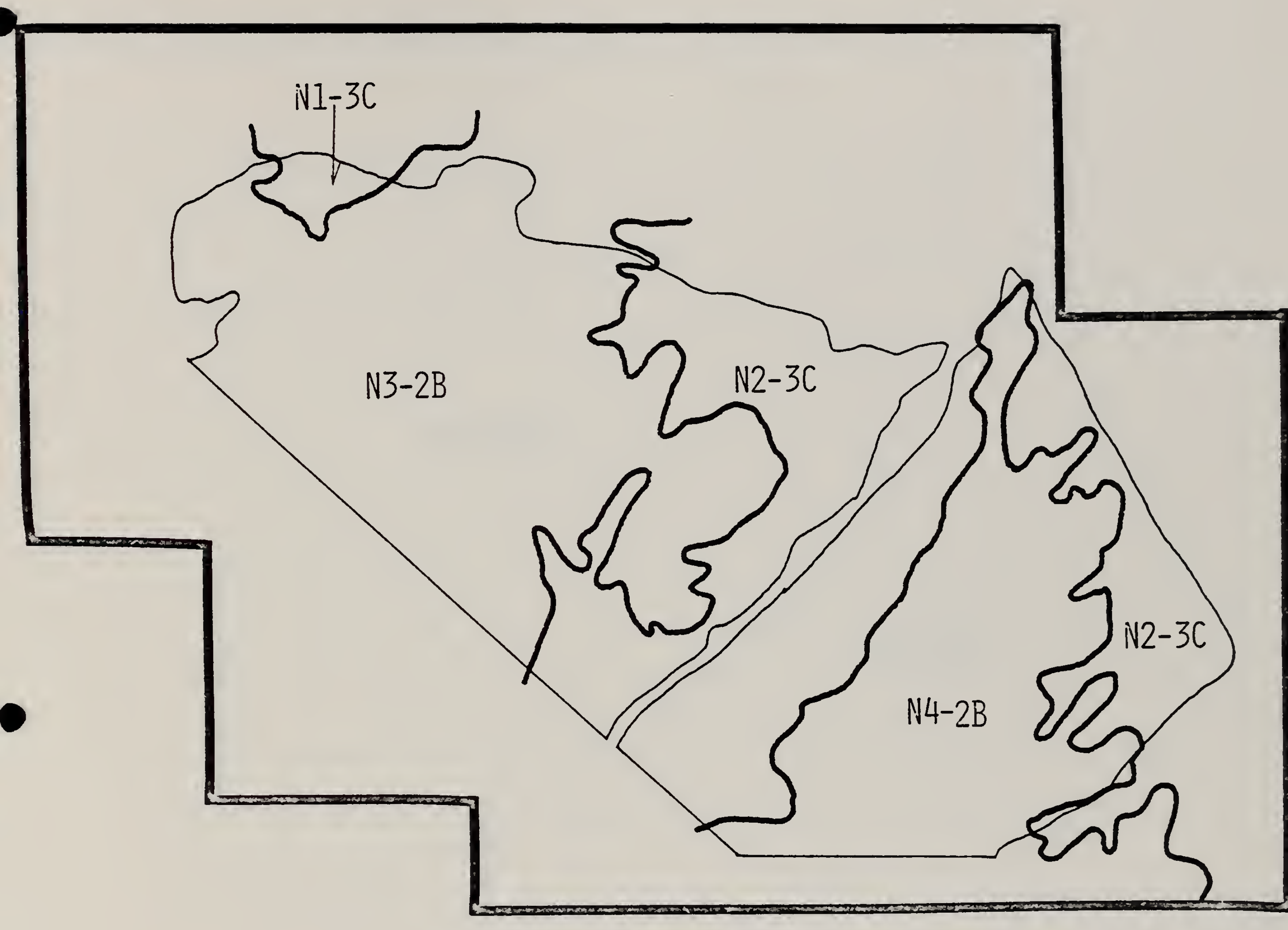
Grapevine Canyon GRA NV-21
Scale 1:250,000

Land Classification - Mineral Occurrence Map/Metallics



Grapevine Canyon GRA NV-21
Scale 1:250,000

Land Classification - Mineral Occurrence Map/Uranium



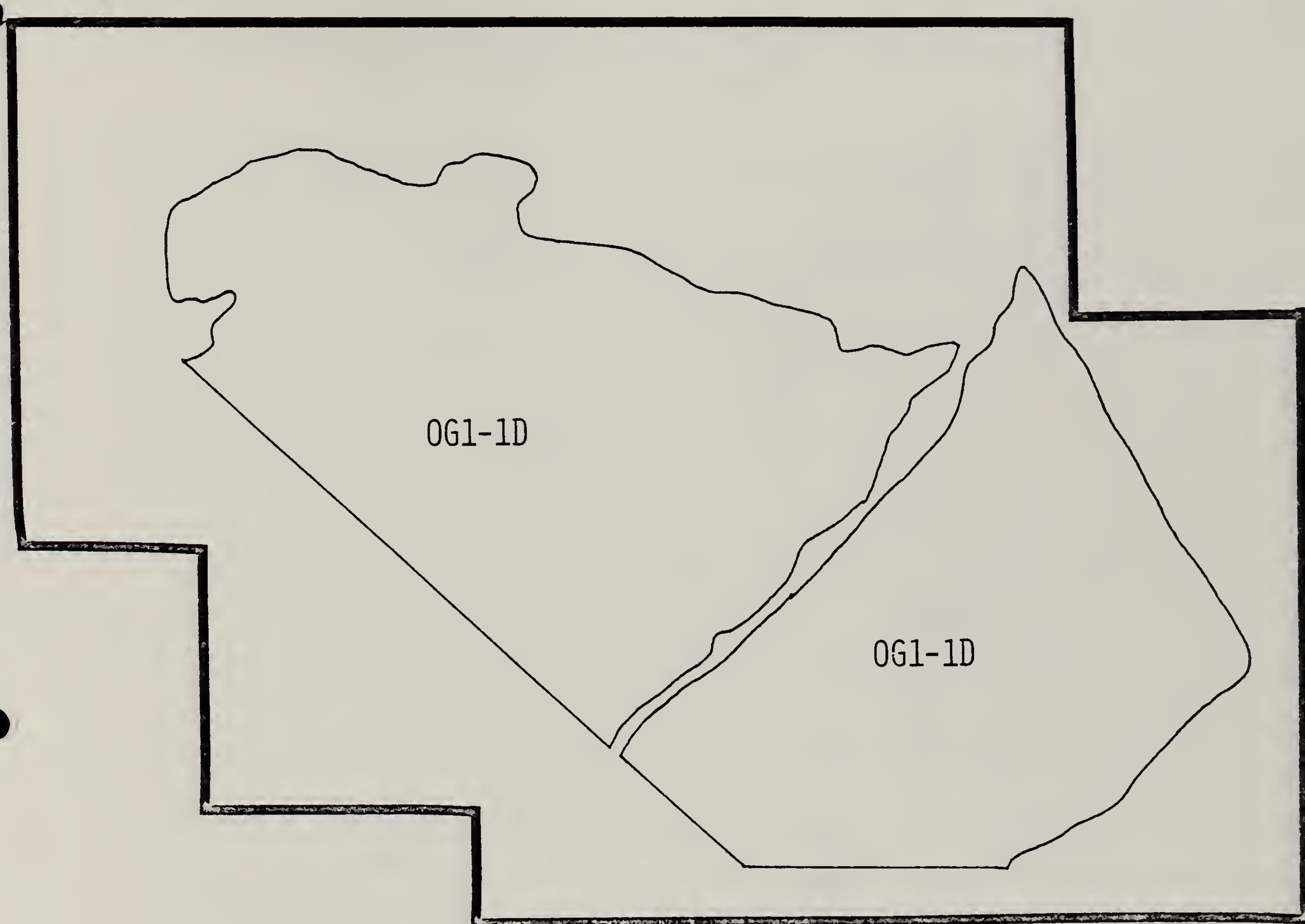
EXPLANATION

Land Classification Boundary

WSA Boundary

Grapevine Canyon GRA NV-21
Scale 1:250,000

Land Classification - Mineral Occurrence Map/Nonmetallics

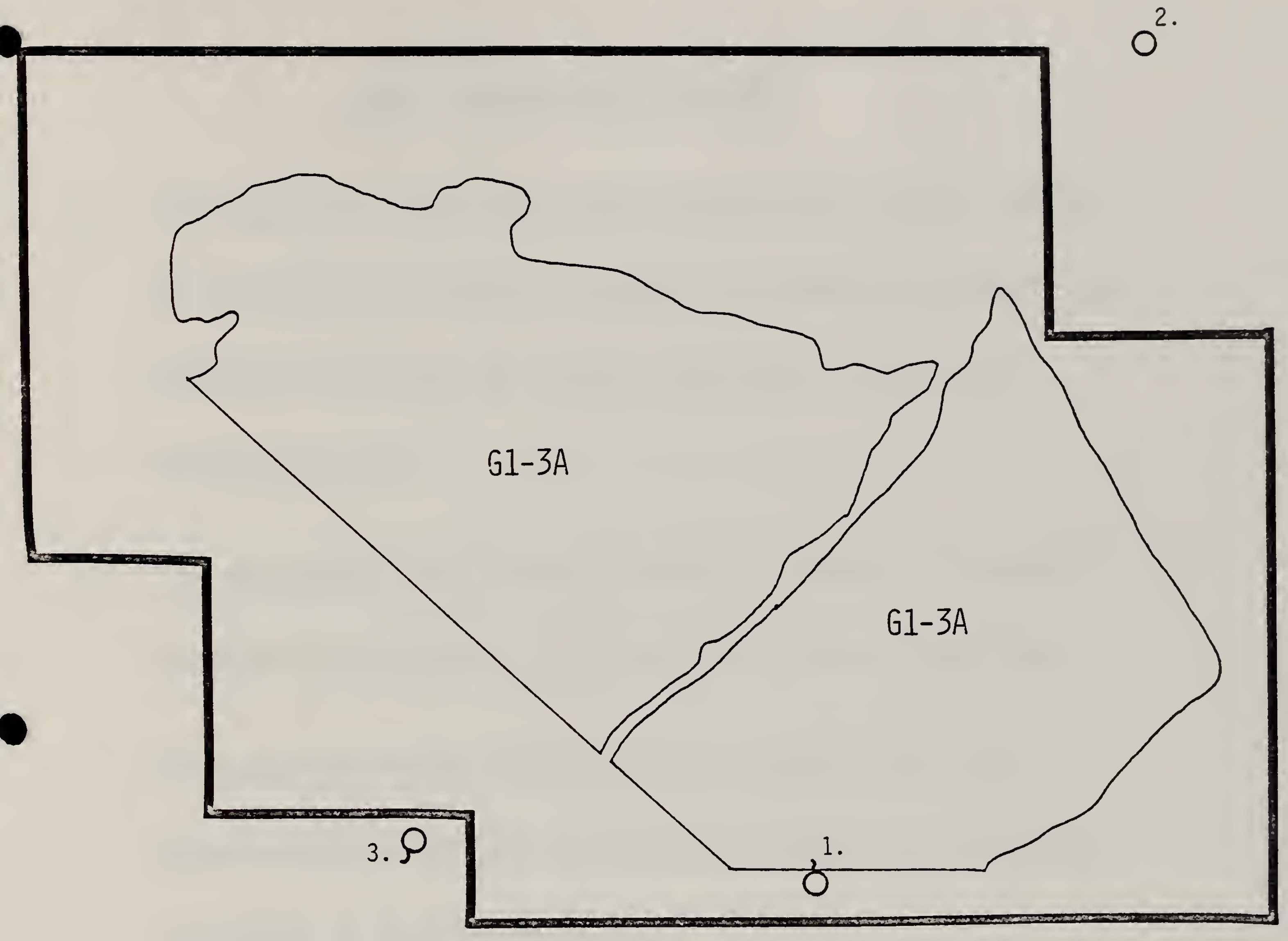


EXPLANATION

—— WSA and Land Classification Boundary

Grapevine Canyon GRA NV-21
Scale 1:250,000

Land Classification - Mineral Occurrence Map/Oil and Gas



EXPLANATION

Thermal Well

Thermal Spring

WSA and Land Classification Boundary

1. Location reference (see text)

Land Classification - Mineral Occurrence Map/ Geothermal

Grapevine Canyon GRA NV-21
Scale 1:250,000

LEVEL OF CONFIDENCE SCHEME

A. THE AVAILABLE DATA ARE EITHER INSUFFICIENT AND/OR CANNOT BE CONSIDERED AS DIRECT EVIDENCE TO SUPPORT OR REFUTE THE POSSIBLE EXISTENCE OF MINERAL RESOURCES WITHIN THE RESPECTIVE AREA.

B. THE AVAILABLE DATA PROVIDE INDIRECT EVIDENCE TO SUPPORT OR REFUTE THE POSSIBLE EXISTENCE OF MINERAL RESOURCES.

C. THE AVAILABLE DATA PROVIDE DIRECT EVIDENCE, BUT ARE QUANTITATIVELY MINIMAL TO SUPPORT TO REFUTE THE POSSIBLE EXISTENCE OF MINERAL RESOURCES.

D. THE AVAILABLE DATA PROVIDE ABUNDANT DIRECT AND INDIRECT EVIDENCE TO SUPPORT OR REFUTE THE POSSIBLE EXISTENCE OF MINERAL RESOURCES.

CLASSIFICATION SCHEME

1. THE GEOLOGIC ENVIRONMENT AND THE INFERRED GEOLOGIC PROCESSES DO NOT INDICATE FAVORABILITY FOR ACCUMULATION OF MINERAL RESOURCES.

2. THE GEOLOGIC ENVIRONMENT AND THE INFERRED GEOLOGIC PROCESSES INDICATE LOW FAVORABILITY FOR ACCUMULATION OF MINERAL RESOURCES.

3. THE GEOLOGIC ENVIRONMENT, THE INFERRED GEOLOGIC PROCESSES, AND THE REPORTED MINERAL OCCURRENCES INDICATE MODERATE FAVORABILITY FOR ACCUMULATION OF MINERAL RESOURCES.

4. THE GEOLOGIC ENVIRONMENT, THE INFERRED GEOLOGIC PROCESSES, THE REPORTED MINERAL OCCURRENCES, AND THE KNOWN MINES OR DEPOSITS INDICATE HIGH FAVORABILITY FOR ACCUMULATION OF MINERAL RESOURCES.

MAJOR STRATIGRAPHIC AND TIME DIVISIONS IN USE BY THE U.S. GEOLOGICAL SURVEY

Erathem or Era	System or Period		Series or Epoch	Estimated ages of time boundaries in millions of years
Cenozoic	Quaternary		Holocene	
			Pleistocene	2-3 [1]
	Tertiary		Pliocene	12 [1]
			Miocene	26 [2]
			Oligocene	37-38
			Eocene	53-54
			Paleocene	65
Mesozoic	Cretaceous [4]		Upper (Late) Lower (Early)	136
	Jurassic		Upper (Late) Middle (Middle) Lower (Early)	190-195
	Triassic		Upper (Late) Middle (Middle) Lower (Early)	225
Paleozoic	Permian [4]		Upper (Late) Lower (Early)	280
	Carboniferous Systems	Pennsylvanian [4]	Upper (Late) Middle (Middle) Lower (Early)	
		Mississippian [4]	Upper (Late) Lower (Early)	345
	Devonian		Upper (Late) Middle (Middle) Lower (Early)	395
	Silurian [4]		Upper (Late) Middle (Middle) Lower (Early)	430-440
	Ordovician [4]		Upper (Late) Middle (Middle) Lower (Early)	500
	Cambrian [4]		Upper (Late) Middle (Middle) Lower (Early)	570
Precambrian [3]			Informal subdivisions such as upper, middle, and lower, or upper and lower, or younger and older may be used locally.	3,600 + [3]

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[3] Stern, T. W., written commun., 1968, for the Precambrian.

[4] Includes provincial series accepted for use in U.S. Geological Survey reports.

Terms designating time are in parentheses. Informal time terms early, middle, and late may be used for the eras, and for periods where there is no formal subdivision into Early, Middle, and Late, and for epochs. Informal rock terms lower, middle, and upper may be used where there is no formal subdivision of a system or of a series.

GEOLOGIC NAMES COMMITTEE, 1970